German Medical Data Sciences: A Learning Healthcare System
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What Are Inter-Professional eHealth Competencies?

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Abstract. As health IT supports processes along the entire patient trajectory and involves different types of professional groups, eHealth is inter-professional by nature. The aim of this study, therefore, is to investigate which competencies are at the intersection of the individual groups of health professionals. 718 international experts provided relevance ratings of eHealth competencies for different professional roles in an online survey. Communication and leadership proved to be important competencies across all professions, not only for executives. None or very little differences between professions were found between physicians and nurses, between IT experts at different levels and between IT experts and executives. However, there were a number of competencies rated differently when contrasting direct patient care specialists with executives. These findings should encourage organisations issuing educational recommendations to specify areas of shared competencies more extensively.

Keywords. eHealth, medical and health informatics, competencies, inter-professional education

1. Introduction

eHealth competency development of health care professionals has been recognized as a major driving force of health IT adoption, which resulted in several influential educational recommendations [1,2]. Competencies comprise a combination of cognitive, motivational, moral and social skills that are directed to meet requirements, solve tasks and problems or achieve goals through the necessary knowledge and the corresponding actions [3]. As health IT supports processes along the entire patient trajectory it involves different types of professional groups that are interacting to achieve the patient outcomes targeted. Thus, in principle, eHealth is inter-professional by nature and must also be reflected in education and training, e.g. of physicians, nurses and other professionals working in direct patient care. Furthermore, shared terminologies and competencies were found to be highly valuable between executives (decision makers) and IT specialists [4,5] or clinical experts in direct patient care. Although inter-professional eHealth education has been postulated as desirable, the empirical base of what competencies should be

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common across different professions is small. Furthermore, little is known about clusters of health professionals with similar eHealth competency profiles and those with different ones. The aim of this study, therefore, is to investigate which competencies lie at the intersection of the individual groups of health professionals. As different educational recommendations deliberately address a global audience, we were interested in pursuing the goal of this study on an international level. The following research questions guided this study: (a) Are there common relevant eHealth competencies across different health professions? (b) Do the relevance ratings of eHealth competencies differ between selected professional groups?

2. Methods

In order to answer these research questions, a quantitative survey to capture the current state of needs about eHealth competencies was performed within the Horizon 2020 project *EU*US eHealth Work* that investigated transatlantic cooperation in eHealth workforce development. This survey also contained questions about other fields in eHealth, which are not part of this study. The section on eHealth competencies embraced questions on assessing their relevance for twelve different professional roles on a scale from 0 to 100. The list of competencies was compiled drawing on a list of 24 items that had been previously developed based on international [1,2] and national recommendations [6], validated and used in two other similar international surveys [7]. This list was augmented by competencies incorporated in the HITCOMP tool [8], a database of competencies and roles. Both sets of competencies were evaluated for overlaps and eventually, 33 eHealth competencies[2] emerged from this mapping process. The survey participants could give relevance ratings for several professional roles they felt competent for. The survey was internally and externally pre-tested and was finally made available online from the middle of February to the end of June 2017. The link was sent either to individuals with known eMail addresses, e.g. HIMSS TIGER (Technology Informatics Guiding Education Reform) or to organisations that are representing eHealth professionals, e.g. at the international level *International Medical Informatics Association* or at the national level *UK Royal College of Nurse*s and *German Association for Medical Informatics, Biometry and Epidemiology*. The target organisations were chosen according to their mission to represent health professionals with direct patient care, health executives, health IT specialists and leaders and experts from science & education, thus aiming to garner views from a wide range of professionals. Due to this deployment approach the sample addressed could not be exactly specified by number.

3. Results

892 participants responded to at least one section of the questionnaire, out of which 718 experts provided answers for the section on eHealth competencies (Table 1). As these experts could rate the relevance for several professional roles, 1,571 replies resulted, which were used for the descriptive top ten rank analysis.[3]

[2] Overview of all 33 competencies https://netcase.hs-osnabrueck.de/index.php/s/4wfTXA8tYnQtOpT

[3] Overview of competence roles https://netcase.hs-osnabrueck.de/index.php/s/QR4LzuFXvEp1xvP

Table 1: Participants' demographics.

Professional background			
Academic or non-academic teaching and / or education [n=101]			Health data management [n=65]
Physician [n=25]			Clinical CEOs [n=20]
Nursing [n=106]			Technical CEOs [n=24]
Pharmacist [n=5]			Clinical CIOs [n=18]
Other health care professions (e.g. physiotherapy) [n=22]			Technical CIOs [n=16]
Other health care institution worker or staff [n=51]			Science & research [n=18]
Engineering or IT specialist [n=129]			Other [n=118]
Gender [n=711]	**Age [n=713]**	**Countries by continent [n=718]**	
Female 70.6 %	Mean 50 years	Africa (2)	Europe (28)
Male 28.6 %	SD 10.99	Asia (10)	North America (2)
Other 0.8%		Australia (1)	Central and South America (8)

In a first step, we looked at which eHealth competencies were represented in the top ten among all professional roles. These were the competencies leadership and communication. In a second step, the professional roles were clustered into the four groups: direct patient care (physicians, nurses, pharmacists, other health care professions), executives (technical and clinical CEOs / CIOs), IT (engineering / IT specialist) and science & education. Health data management was excluded in this analysis. Table 2 shows the common competencies that were found in the top ten among the different professional roles in each cluster.

Table 2: Common top ten eHealth competencies for professional roles (number of replies in brackets).

Direct patient care (401)	**Executives (132)**	**IT (172)**	**Science / education (274)**
Leadership	Leadership	Leadership	Leadership
Communication	Communication	Communication	Communication
Ethics in health IT		Ethics in health IT	Ethics in health IT
Documentation		Documentation	Learning techniques
Teaching, training and education in health care		Data protection & security	Teaching, training and education in health care
Quality and safety management		Health care processes and IT integration	Principles of health informatics
Info. / knowledge management in patient care		Interoperability and integration	Info. / knowledge management in patient care
		Process management	Data protection & security
		Project management	
		Info. / communication tech. (applications)	

Professions within direct patient care shared seven and science & education shared eight competencies out of the top ten, professional roles belonging to the cluster IT shared all competencies (cluster consists of a homogeneous group) while executives only shared two. Again, leadership and communication were found to be a horizontal competency across all professional clusters (green), followed by ethics in health IT shared by three clusters (blue). Competencies that occurred twice are marked in orange and those only once in grey.

In order to test these descriptive findings, we carried out binary logistic regressions for selected pairwise comparisons (Table 3). In particular, we wanted to know, whether physicians and nurses were different regarding the relevance ratings of competencies, whether IT differs from executives, whether IT engineers differ from IT leaders and finally, whether professions engaged in direct patient care differ from those working as executives. To this end, the relevance rating of an expert was limited to his / her

professional background. Thus, the relevance rating for the professional role e.g. "physician" was only counted if the rater's professional background was "physician" in order to increase the authenticity of the individual answers. This, however, reduced the number of ratings per professional role.

Table 3: Binary logistic regression with professions as criterion and competencies as predictors.

Physician [n=18] Nursing [n=82][1,2]	IT [n=140] Executives [n=77][1,3]	Sig. p≤0.05	OR	IT [n=140] CIOs [n=37][1,3]	Sig. p≤0.05	OR
No significant differences	Medical technology	.035	0.977	Change and stakeholder management	.018	1.083
	Teaching, training, edu. in health care	.035	1.032			
	Financial management	.034	1.035			

Executives [n=77][1] vs. Direct patient care [n=118][3]	Sig. p≤.05	OR
Teaching, training and education in health care	.000	0.844
Medical technology	.000	0.863
System lifecycle management	.001	0.896
Information and knowledge management in patient care	.025	0.925
Legal issues in health IT	.007	0.927
Documentation	.036	0.943
Public health informatics	.036	0.951
eHealth, mHealth, telematics and telehealth	.045	1.039
Clinical decision support by IT	.030	1.053
Interoperability and integration	.028	1.062
IT risk management	.029	1.079
Process management	.028	1.080
Strategic management	.026	1.088
Ethics in health IT	.005	1.103
Leadership	.009	1.119

[1] Reference category; [2] Calculated with combined mean value over the roles physician, nursing, other health care professions (direct patient care); [3] Calculated with the combined mean value over all roles.

Table 3 reveals that there were no differences in rating the relevance of all 33 competencies (for direct patient care) between physicians and nurses. The averaged ratings for each of the 33 competencies shows that IT experts and CIOs differed only regarding change and stakeholder management, which received a higher odds ratio (OR) value in favour of CIOs. IT experts also differed from executives - in this case regarding three competencies. The largest group of competencies with different relevance rating occurred when comparing executives and professionals with direct patient care responsibilities. A total of fifteen competencies showed significant OR values either marking a larger chance for executives, e.g. leadership, ethics in health IT or a larger chance for clinicians, e.g. information and knowledge management in patient care.

4. Discussion

This study provides a first overview of what inter-professional eHealth education could mean as investigated from a global perspective, which provides evidence that physicians and nurses can be educated together. It seems that there are several differences regarding the relevance of competencies between executives and direct patient care specialists. Leadership and communication geared to eHealth adoption and use are competencies that exist across the entire professional spectrum. While leadership and communication competencies [2,7] can be found explicitly or implicitly in recommendations, their

paramount importance and link between the professions has not been pointed out that clearly before. Some findings are surprising, e.g. ethics in health IT as well as data protection and security not appearing as common competencies for executives. However, they are included if the top 15 are analysed.

This study has some limitations due to small number of experts when testing the findings for significance, in subgroups. Caution therefore needs to be exercised. Still, these results point to the fact that there is a considerable number of competencies at the intersection of health professions which underpin the role of eHealth as a catalyst and focal point of inter-professional cooperation.

5. Conclusion

These findings should encourage organisations issuing educational recommendations to specify areas of shared competencies more extensively and explicitly.

6. Conflict of Interest

There is no conflict of interest.

7. Acknowledgment

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